

## Low Temperature Alpha Measurement

David J. Gallant

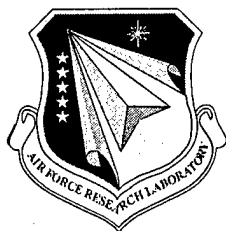
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July 2001

Final Report

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20040218 077



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**REPORT DOCUMENTATION PAGE**Form Approved  
OMB No. 074-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE  
25-07-20013. REPORT TYPE AND DATES COVERED  
FINAL; 22-03-2000 - 22-03-2001

## 4. TITLE AND SUBTITLE

Low Temperature Alpha Measurement

## 5. FUNDING NUMBERS

F29601-00-D-0169  
Order No. 0004

## 6. AUTHOR(S)

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Program Element: 62601F  
Project: 3326  
Task: LR  
Work Unit: AA

## 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

The Boeing Company  
Rocketdyne Technical Services  
PO Box 5670  
Kirtland AFB, NM 871858. PERFORMING ORGANIZATION  
REPORT NUMBER

01RTS067

## 9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Air Force Research Laboratory/DELO  
3550 Aberdeen Ave SE  
Kirtland AFB, NM 87117-577610. SPONSORING / MONITORING  
AGENCY REPORT NUMBER

AFRL-DE-TR-2001-1065

## 11. SUPPLEMENTARY NOTES

## 12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release, distribution is unlimited.

## 12b. DISTRIBUTION CODE

## 13. ABSTRACT (Maximum 200 Words)

The objective of this task was to provide for the setup, measurement and data analysis of an experiment to measure the alpha parameter of diode lasers. The alpha parameter characterized the degree of coupling between the diode laser carriers and the material index of refraction. This parameter has been measured extensively at room temperature and this task extended the measurement regime to low temperatures.

## 14. SUBJECT TERMS

alpha parameter, diode lasers, low temperatures, alpha measurement

## 15. NUMBER OF PAGES

10

## 16. PRICE CODE

17. SECURITY CLASSIFICATION  
OF REPORT

Unclassified

18. SECURITY CLASSIFICATION  
OF THIS PAGE

Unclassified

19. SECURITY CLASSIFICATION  
OF ABSTRACT

Unclassified

## 20. LIMITATION OF ABSTRACT

Unlimited

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## Table of Contents

Section	Page
I. Introduction	1
II. Low Temperature Alpha Measurements	2
III. Conclusion	3



## I. INTRODUCTION

The SLIDERS contract encompassed several research efforts within the Semiconductor Laser Branch of the Laser Division, Directed Energy Directorate of the Air Force Research Laboratory. The scope of this contract included development, design, fabrication, procurement, management, operations and maintenance of optical, electronic, and mechanical systems, subsystems, and components. Principal efforts included theory and concept development, design analysis, laboratory operations, and semiconductor laser and diode-pumped laser development, operation and maintenance. Efforts also included the development, procurement, and operation of instrumentation to evaluate and characterize laser systems.

## II. LOW TEMPERATURE ALPHA MEASUREMENT

The objective of this task was to provide for the setup, measurement and data analysis of an experiment to measure the alpha parameter of diode lasers. This work was a continuation of previous work on alpha parameter measurements, and was to extend measurement capabilities to other operating temperatures. The alpha parameter is a measure of the coupling between the diode laser carriers (electron current) and the material index of refraction. A lower coupling parameter is required to reduce nonlinear effects and filamentation, leading to improved beam quality and higher facet powers.

At the initiation of the task recent efforts on this experiment were reviewed and the optical layout was examined. Some of the optics were realigned, and changes to the vacuum chamber and laser mount were incorporated to facilitate an alignment laser through the vacuum chamber. Other vacuum chambers and cryogenic systems were looked into in order to vary the operating temperature of the test samples.

Additional parts were designed and machined to allow for the alignment laser and to better support the electrical current probe used to run the diode laser. The availability of diode laser samples and material on hand was reviewed.

Discussions were held with DOF personnel concerning anti-reflective optical coatings on the laser diodes. DOF typically builds a two layer AR coating so our coating model will have to be modified to account for the two layers and fixed material indices. Getting good quality optical coatings is critical. The coatings must withstand cryogenic temperatures and provide sufficient suppression of lasing for high carrier density alpha measurements.

We continued to pursue obtaining optical AR coating from the DOF. DOF contractual changes that were ongoing made it difficult to establish a new task with DOF. Computer models were run for coating specifications to be deposited.

Machining of parts for optical and electronic mounting was completed. L/I data was taken on several samples of quantum dot material received from Wright-Patterson AFB. Initial L/I curves indicated poor laser efficiencies, subsequent measurements on different bars showed better characteristics.

Subsequent to this activity the Air Force branch decided to move the laboratory to a new facility. Equipment from the lab was boxed and tables were cleared in preparation for moving. All of the remaining lab equipment was moved into the hanger lab including the Argon-ion laser, the Ti-sapphire laser, spectrometers and the alpha measurement setup. Organization of the new lab was started but was slowed due to changing space requirements within the Air Force branch.



### III. CONCLUSION

Alpha measurements made prior to this task suggest that low temperature operation of diode lasers may decrease the alpha parameter leading to improved laser performance. Due to laboratory reorganization and consolidation, technical activity on this task was curtailed, and lowered alpha parameters could not be verified. Continued work in this area is appropriate, and may lead to higher power, higher brightness diode lasers.

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